



Competition on Single Objective Bound Constrained Numerical Optimization

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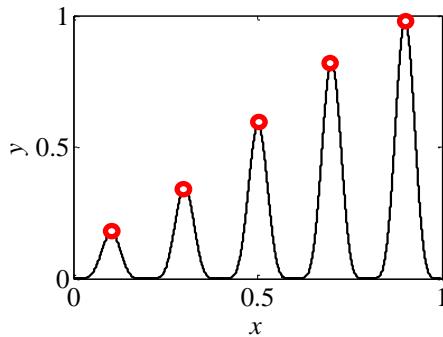
- Introduction
- A review for CEC2020 benchmark problems
- Accepted algorithms
- Evaluation criteria
- Ranking result

Introduction

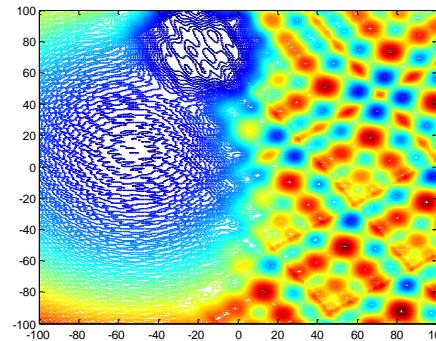
Single objective optimization algorithms are the foundation upon which more complex methods.

In the recent years various kinds of novel optimization algorithms have been proposed to solve real-parameter optimization problems.

Improved methods and problems sometimes require updating traditional testing criteria.



Multimodal single objective optimization

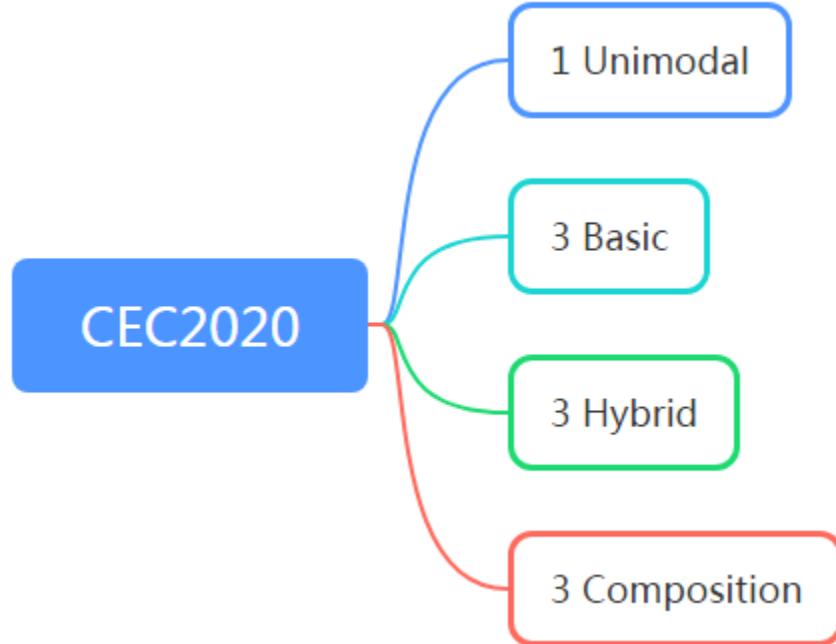


Complex single objective optimization

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A review for CEC2020 benchmark problems



This competition significantly increases the maximum number of allowed function evaluations

A review for CEC2020 benchmark problems

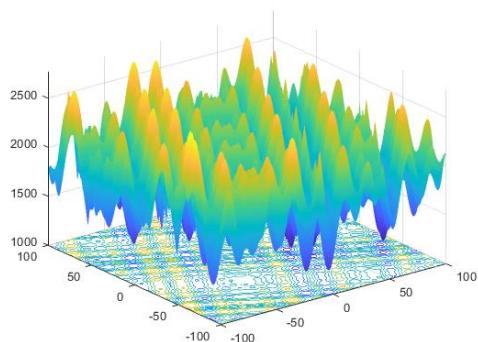
Information and features of the MMO test problems suite

| | No. | Functions | $F_i^* = F_i(\mathbf{x}^*)$ |
|-----------------------|-----|---|-----------------------------|
| Unimodal Function | 1 | Shifted and Rotated Bent Cigar Function (CEC 2017 F1) | 100 |
| Basic Functions | 2 | Shifted and Rotated Schwefel's Function (CEC 2014 F11) | 1100 |
| | 3 | Shifted and Rotated Lunacek bi-Rastrigin Function (CEC 2017 F7) | 700 |
| | 4 | Expanded Rosenbrock's plus Griewangk's Function (CEC2017 f_{19}) | 1900 |
| Hybrid Functions | 5 | Hybrid Function 1 ($N = 3$) (CEC 2014 F17) | 1700 |
| | 6 | Hybrid Function 2 ($N = 4$) (CEC 2017 F16) | 1600 |
| | 7 | Hybrid Function 3 ($N = 5$) (CEC 2014 F21) | 2100 |
| Composition Functions | 8 | Composition Function 1 ($N = 3$) (CEC 2017 F22) | 2200 |
| | 9 | Composition Function 2 ($N = 4$) (CEC 2017 F24) | 2400 |
| | 10 | Composition Function 3 ($N = 5$) (CEC 2017 F25) | 2500 |

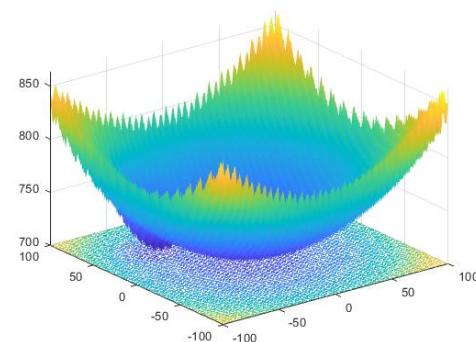
Search range: [-100,100]^D

A review for CEC2020 benchmark problems

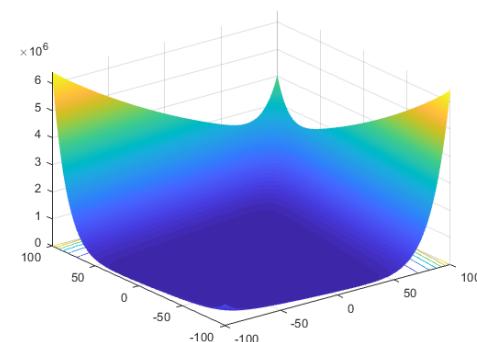
3-D map for some of functions in CEC2020



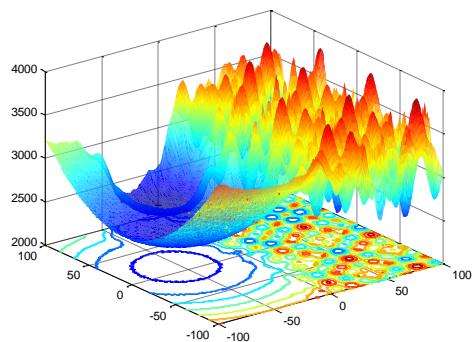
F2



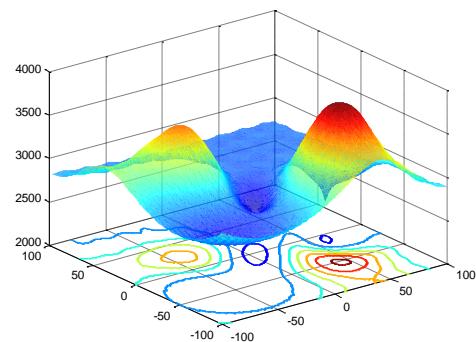
F3



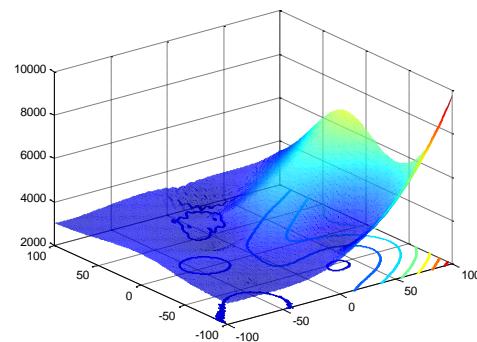
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F9



F10

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Accepted Algorithms

| | Paper ID | Algorithm | Paper Title |
|---|----------|------------|--|
| 1 | E-24139 | CSsin | Improving Cuckoo Search: Incorporating Changes for CEC 2017 and CEC 2020 Benchmark Problems |
| 2 | E-24165 | MP-EEH | A Multi-Population Exploration-only Exploitation-only Hybrid on CEC-2020 Single Objective Bound Constrained Problems |
| 3 | E-24355 | RASP-SHADE | Ranked Archive Differential Evolution with Selective Pressure for CEC 2020 Numerical Optimization |
| 4 | E-24365 | IMODE | Improved Multi-operator Differential Evolution Algorithm for Solving Unconstrained Problems |
| 5 | E-24380 | DISH-XX | DISH-XX Solving CEC2020 Single Objective Bound Constrained Numerical Optimization Benchmark |

Accepted Algorithms

| | Paper ID | Algorithm | Paper Title |
|----|----------|------------|---|
| 6 | E-24505 | AGSK | Evaluating the Performance of Adaptive Gaining-Sharing Knowledge Based Algorithm on CEC 2020 Benchmark Problems |
| 7 | E-24518 | j2020 | Differential Evolution Algorithm for Single Objective Bound-Constrained Optimization: Algorithm j2020 |
| 8 | E-24559 | jDE100e | Eigenvector Crossover in jDE100 Algorithm |
| 9 | E-24597 | OL SHADE | Large Initial Population and Neighborhood Search incorporated in L SHADE to solve CEC2020 Benchmark Problems |
| 10 | E-24623 | mpmL-SHADE | Multi-population Modified L-SHADE for Single Objective Bound Constrained Optimization |
| 11 | GECCO | SOMA_CL | SOMA-CL for Competition on Single Objective Bound Constrained Numerical Optimization Benchmark |

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Evaluation Criteria

SE: Summation of Errors → $Score_1$

$$SE = 0.1 \sum_{i=1}^8 ef_{5D} + 0.2 \sum_{i=1}^{10} ef_{10D} + 0.3 \sum_{i=1}^{10} ef_{15D} + 0.4 \sum_{i=1}^{10} ef_{20D}$$

$$Score_1 = \left(1 - \frac{SE - SE_{\min}}{SE} \right) \times 50$$

SR: Summation of Rankings → $Score_2$

$$SR = 0.1 \sum_{i=1}^8 rank_{5D} + 0.2 \sum_{i=1}^{10} rank_{10D} + 0.3 \sum_{i=1}^{10} rank_{15D} + 0.4 \sum_{i=1}^{10} rank_{20D}$$

$$Score_2 = \left(1 - \frac{SR - SR_{\min}}{SR} \right) \times 50$$

$$Score = Score_1 + Score_2$$

The evaluation method is based on the final score ranging from 1 to 100.
Higher weights are given for higher dimensions.

Contents

- Introduction
- Test problems suite
- Indicators and rules
- Participants
- Comparison method
- Ranking result

Ranking Result

Final Ranking of the accepted algorithms

| Algorithm | <i>Score</i>₁ | <i>Score</i>₂ | <i>Score</i> | Ranking |
|------------------|---------------------------------|---------------------------------|---------------------|---|
| CSsin | 6.77E-06 | 29.07801 | 29.07802 | 11 |
| MP-EEH | 30.54376 | 25 | 55.54376 | 9 |
| RASP-SHADE | 33.50507 | 33.19838 | 66.70345 | 6 |
| IMODE | 50 | 50 | 100 | 1  |
| DISH-XX | 27.0024 | 23.66522 | 50.66762 | 10 |
| AGSK | 46.19854 | 48.23529 | 94.43383 | 2  |
| j2020 | 43.70529 | 45.42936 | 89.13465 | 3  |
| jDE100e | 33.19863 | 38.40749 | 71.60612 | 5 |
| OLSHADE | 48.69822 | 30.48327 | 79.1815 | 4 |
| mpmL-SHADE | 30.52644 | 34.96802 | 65.49445 | 7 |
| SOMA_CL | 30.7555 | 25.30864 | 56.06414 | 8 |



Thanks for your attention!